AUTOMATIC MILKING: FARM ECONOMIC ASPECTS

Henk Hogeveen, Paul B.M. Berentsen and Marcel A.P.M. van Asseldonk

Farm Management Group
Wageningen University
Hollandseweg 1
6706 KN Wageningen
The Netherlands
henk.hogeveen@alg.abe.wau.nl
paul.berentsen@alg.abe.wau.nl
marcel.van.asseldonk@alg.abe.wau.nl

Introduction

From the 1970's research of automation on dairy farms started with the development of reliable cow identification systems. The first applications were automatic concentrate feeders. With the introduction of milk yield recording equipment, automation started also in the milking parlour. At the same time, developments of milking technology reduced labour input during milking. In a well-equipped milking parlour, the tasks of the milker are limited to attachment of the teat cups and control of the milk and the cow. To study the last step in total automation of the milking process, in the mid 1980's a concentrate feeder was used to build a 1 cow milking parlour. Cows could enter the concentrate feeder 24 hours a day. When cows entered, the milking cluster was attached manually. This first experiment showed that, in principle, it would be possible to automatically milk a cow in a concentrate feeder (Rossing et al., 1985). The last and most challenging step in the complete automation of milking was the development of automated cluster attachment. In the beginning of the 1990's, a series of cluster attachment principles were in development. Finally, in 1992 the first automatic milking systems were installed at commercial dairy farms in the Netherlands. Since that time, developments have gone fast. In Europe, almost all dairy equipment companies have an AM-system in their range of products and AM has become a fact instead of fiction. In the first years, the number of farms with an AM-system did not increase very rapidly. From 1998, in the Netherlands AM became an accepted technology by a large part of the dairy sector and also other countries adopted AM-systems. In January 2001, world-wide more than 700 commercial farms used one or more AM-systems to milk their cows (Hogeveen et al., 2001). Many farms have, because of the number of cows to be milked, more than one milking stall on their farm. Therefore, the number of sold AM-systems is much higher than 700. Most dairy farms with an AM-system can be found in the Netherlands. And more than 90 % of all dairy farms with an AM-system are located in north-western Europe (Hogeveen et al., 2001).

Since dairy farms are economic enterprises and the investments in an AMS are higher than in a traditional milking parlour, economics will play a role. This paper gives a broad overview of the published studies on the economic aspects of automatic milking.

Economic studies

Five studies were found on economic aspects of automatic milking: Arendzen and van Scheppingen (2000), Armstrong and Daugherty (1997), Cooper and Parsons (1999), Dijkhuizen et al., (1997) and Pellerin et al. (2001).
In the study of Arendzen and van Scheppingen (2000), the cost-effectiveness of an AMS compared to a traditional milking parlour is calculated using the room for investment (RFI) methodology. The RFI is the total amount of money which may be invested in an AMS on the farm so that the yearly income will remain the same as with an traditional milking parlour. The calculations are based on the farm simulation model

BBPR of the Research Institute for Animal Husbandry in the Netherlands (Mandersloot et al., 1999). The following factors are used in the calculations to compare an AMS with a milking parlour: returns from an increase in milk yield, savings in labour costs, annual costs (price of the milking parlour, annual costs for maintenance and depreciation of the AMS based on price and maintenance. The basis farm consisted of 133 cows with 1.000.000 kgs of milk quotum. Basic calculations assumed a decrease in labour costs with 10%, an increase in milk production per cow of 10 % and the annual costs of the AMS were assumed to be 25 % of the replacement value of the AMS.

The study of Armstrong et al. (1992) and Armstrong and Daugherty (1997) was directed at large farms in the US situation. Since at the time of the study, no prices of AMS were available, the study is based upon cash outflows (capital investment, capital replacement and pertinent costs) of 4 types of milking parlous for a 15 year planning period for a 500 cow and a 1500 cow herd. It was calculated that the labour costs did not change much when changing from 2 to 3 times per day milking. Therefore, no milk production increase was expected and labour savings should pay the additional costs for an AMS. This latter assumption is rather strange in the eyes of the authors.

Cooper and Parsons (1999) carried out a cost-benefit analysis in which they calculated the extra profit of an AMS compared to a milking parlour with a high level of automation. The yearly profit minus the annual costs for the milking equipment was calculated for a farm with an AMS and a farm with a milking parlour. The differences were compared. Profits were defined as milk sales minus labour costs, feeding costs and other costs. The latter is assumed to be equal for both type of farms. Calculations were made for a farm of 125 cows. An increase of milk production of 10-15 % was assumed and a decrease in labour was estimated at 18%. This is under the assumption that a conventional farm is grazing the cows and the AMS has a zero-grazing system.

Dijkhuizen et al. (1997) used capital budgetting procedures to calculate the room for investment. By cumulating the yearly net return (after tax), the remaining value of the system and the investment costs, the net present value of a system (either AMS or a milking parlour) is calculated. Because of differences in the depreciation time of an AMS and a milking parlour, yearly net return was standardised. In this study a decrease of labour for milking of almost 70 % and an increase of milk production of 10 to 15 % were assumed. The increase in milk production was combined with a decrease in fat and protein content of 0.15 %.

Pellerin et al. (2001) have calculated the cost-effectiveness of an AMS using partial budgeting for a farm of 50, 100 and 200 cows. With partial budgetting only the additional costs and benefits of a system are compared and calculated. Basic assumptions were a decrease of labour of 50 % for milking, an increase of milk production of 5 %, an increase of energy consumptioin of 50 %, an increase of feeding costs of 0,25 $Ca per hectoliter milk, an increase in calving interval of 10 days and an increase in penalties for milk quality of 8 %.

Results and discussion

The room for investment, as calculated in the various studies with the input described above, is presented in Table 1. It can be seen that the RFI differs between the studies. The study that has been carried out for large dairies under US circumstances came with a very low RFI. The outcome of both Dutch studies are rather well comparable. The UK study gave the highest room for investment. However, in this study a rather large change in management was assumed, changing from grazing to a zero-grazing system. Keeping in mind the investment for a one-box system (for approximate 60 cows) of Euro 135,000,-.It seems that the additional returns do not offset the additional costs. The study for Québec did not give a room for investment calculation (Pellerin et al., 2001). In this study, the net farm income (including labour) was calculated. The net farm income was calculated to be lower for a farm with an AMS than for a farm without an AMS. The difference varied from $Ca 5,500.- for a 50 cow herd to $Ca 43,500 for a 200 cow herd.

Table 1. The room for investment (* 1,000 Euro) as calculated by A: Arendzen and van Scheppingen (2000), B: Armstrong and Daugherty (1997), C: Cooper and Parsons (1999), D: Dijkhuizen et al. (1997) and E: Pellerin et al (2001).

	A	B		C	D	E		
country	NL	USA		UK	NL	Canada (Québec)		
# cows	133	500	1500	86	125	50	100	200

RFI	125	233[1]	189[1]	175	141	?[2]	?[2]	?[2]
RFI/60 cows	56	27	7	122	67			

[1]Assuming an investment life of 10 years
[2]Not known

Preliminary calculations for the mid west region in the US showed a positive effect of automatic milking on the cost price of milk (Reinemann and Jackson Smith, 2000). Based on these calculations, Rodenburg and Kelton gave also a positive evaluation the introduction of automatic milking in Ontario (Canada). However, these calculations are difficult to verify.

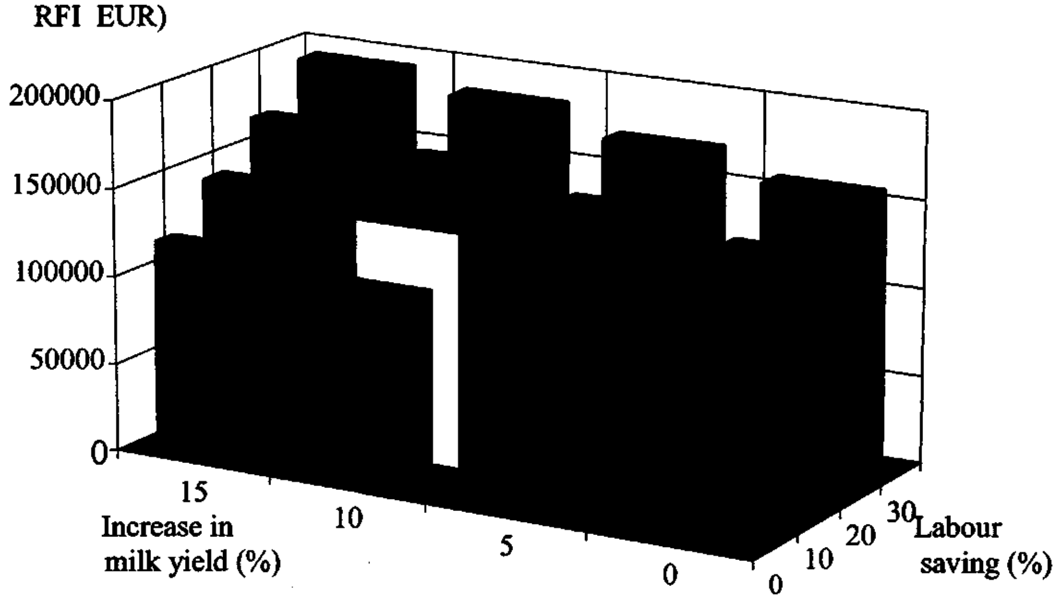

Figure 1. Room for investment with increase of milk yield varying from 0 to 15 % and labour savings varying from 0 to 30 %, given an annual cost of an AMS of 25 % of the replacement value.

The cost-effectiveness of AMS is very dependent on technical results. Figure 1 gives results of a sensitivity analysis of Arendzen and van Scheppingen (2000). Both labour savings and increase in milk production have been varied. The difference between the maximum and minimum RFI is more than Euro 110,000,-. This shows that technical results obtained with automatic milking are a very important factor in the cost-effectiveness of the AMS. This subject needs attention in the future. Moreover, the technical farm results of farms with an AMS are not precisely known and those are important to be able to calculate the cost-effectiveness of the investment. At the Farm Management Group of Wageningen University, in co-operation with the Research Institute of Animal Husbandry, a study is carried out to calculate the cost-effectiveness of automatic milking using technical results from the Dutch practise. These calculations will be carried out using a linear programming (LP) model of a dairy farm designed by Berentsen and Giesen (1995). Using this LP model, labour income is maximised.
The difference in labour savings between 0 % and 30 % saving of labour is Euro 74,000 (Figure 1). However, from a farm-economic point of view labour savings only add to the net farm income, when there is an alternative usage for the labour or when less labour has to be hired. This adds to the fact that even with labour savings taken into account the investment in an AMS is not cost-effective. However, many farmers have invested in an AMS. There must be other reasons to do so. Important reasons might be the change of labour load. Milking has to be carried out twice a day, 7 days a week at unsocial hours.

Replacing this labour might be worth much money. Moreover, in some countries it becomes more and more difficult to hire skilled labour force and an AMS might help with that. On family farms, the difficulties to hire labour (administrative tasks, social security premiums, the risk of illness etc.) might be an incentive to invest in an AMS. Finally image might play a part, especially in the first farms investing in an AMS (Meskens et al., 2001).

In general, one of the key factors influencing the adoption process is the perceived economic gains that producers will reap from technology. This stresses the importance of cost-effectiveness, especially now that the early adopters have already invested in an AMS. Moreover, it is expected that in EU countries the milk price will drop in the near future, which will make the dairy farmer more conscious of the cost price of milk.

Conclusions

From several desk studies, all based upon assumptions, it is clear that from a pure farm-economical point of view investment in an AMS is not cost-effective. However, many dairy farmers have invested in automatic milking indicating that there are other reasons besides pure farm-economical reasons to invest in an AMS.

References

Arendzen, I. and A.T.J. van Scheppingen. 2000. Economical sensitivity of four main parameters defining the room for investment of automatic milking systems on dairy farms. Page 201-211 in: H. Hogeveen and A. Meijering (editors). Robotic milking, Proceedings of the International Symposium, Wageningen Pers, Wageningen, the Netherlands.

Armstrong, D.V. and L.S. Daugherty. 1997. Milking robots in large dairy farms. Computers and Electronics in Agriculture 17: 123-128.

Armstrong, D.V., L.S. Daugherty, D.M. Galton and W.A. Knoblauch. 1992. Analysis of capital investment in robotic milking systems for U.S. dairy farms. Page 432-439 in: A.H. Ipema, A.C. Lippus, J.H.M. Metz and W. Rossing (editors), Prospects for automatic milking, Pudoc Scientific Publishers, Wageningen, The Netherlands.

Berentsen, P.B.M. and G.W.J. Giesen. 1995. An environmental –economic model at farm level to analyze institutional and technical change in dairy farming. Agricultural Systems 49: 153-175.

Cooper, K. and D.J. Parsons. 1999. An economic analysis of automatic milking using a simulation model. Journal of Agricultural Engineering Research 73: 311-321.

Dijkhuizen, A.A., R.B.M. Huirne, S.B. Harsh and R.W. Gardner. 1997. Economics of robot application. Computers and Electronics in Agriculture 17: 111-121.

Hogeveen, H., Y. van der Vorst, K. de Koning and B.A. Slaghuis. 2001. Concepts and implications of automatic milking (in French). Page 103-120 in: Des défis? Des solutions! 25e Symposium sur les bovins laitiers. Saint Hyacinthe, Québec, Canada.

Mandersloot, F, A.T.J. van Scheppingen and J.M.A. Nijssen. 1999. A dairy farm budget program as a tool for planning and evaluation. Page 216 in: Book of abstracts, 50th Annual Meeting of the European Association for Animal Production, Wageningen Pers, Wageningen, the Netherlands.

Meskens, L., M. Vandermersch and E. Mathijs. 2001. Literature review on the determinants and implications of technology adoption. Deliverable of the EU project Implication of the introduction of automatic milking on dairy farms. http://www.automaticmilking.nl

Pellerin, D., M. Blin, P. Meunier, E. Lapeze and R. LeVallois. 2001. Can you pay a milking robot? (in French). Page 121-131 in: Des défis? Des solutions! 25e Symposium sur les bovins laitiers. Saint Hyacinthe, Québec, Canada.

Reinemann, D.J. and D. Jackson Smith. 2000. Evaluation of automatic milking systems for the United States. Page 232-238 in: H. Hogeveen and A. Meijering (editors). Robotic milking, Proceedings of the International Symposium, Wageningen Pers, Wageningen, the Netherlands.

Rodenburg, J. and D.F. Kelton. 2001. Automatic milking systems in North America: Issues and challenges unique to Ontario. Page 163-169 in National Mastitis Council Annual Meeting Proceedings, NMC, Madison, WI, USA.

Rossing, W, A.H. Ipema and P.F. Veltman. 1985. The feasibility of milking in a feeding box. IMAG Research Report 85-2, Wageningen, The Netherlands.

64